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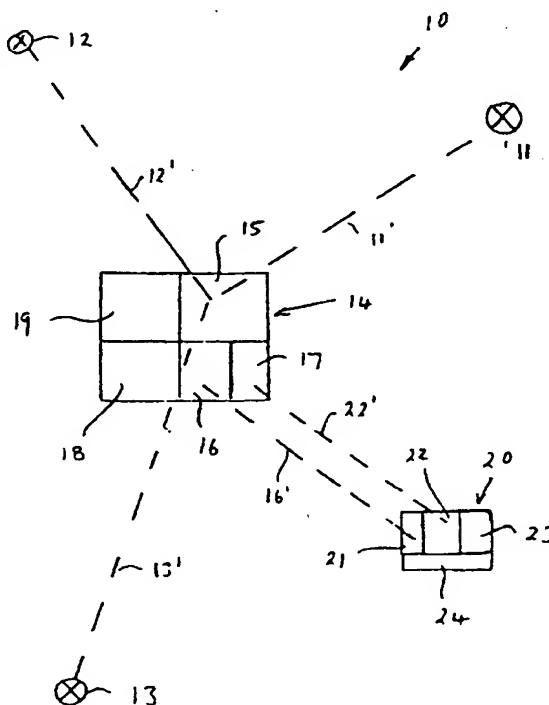
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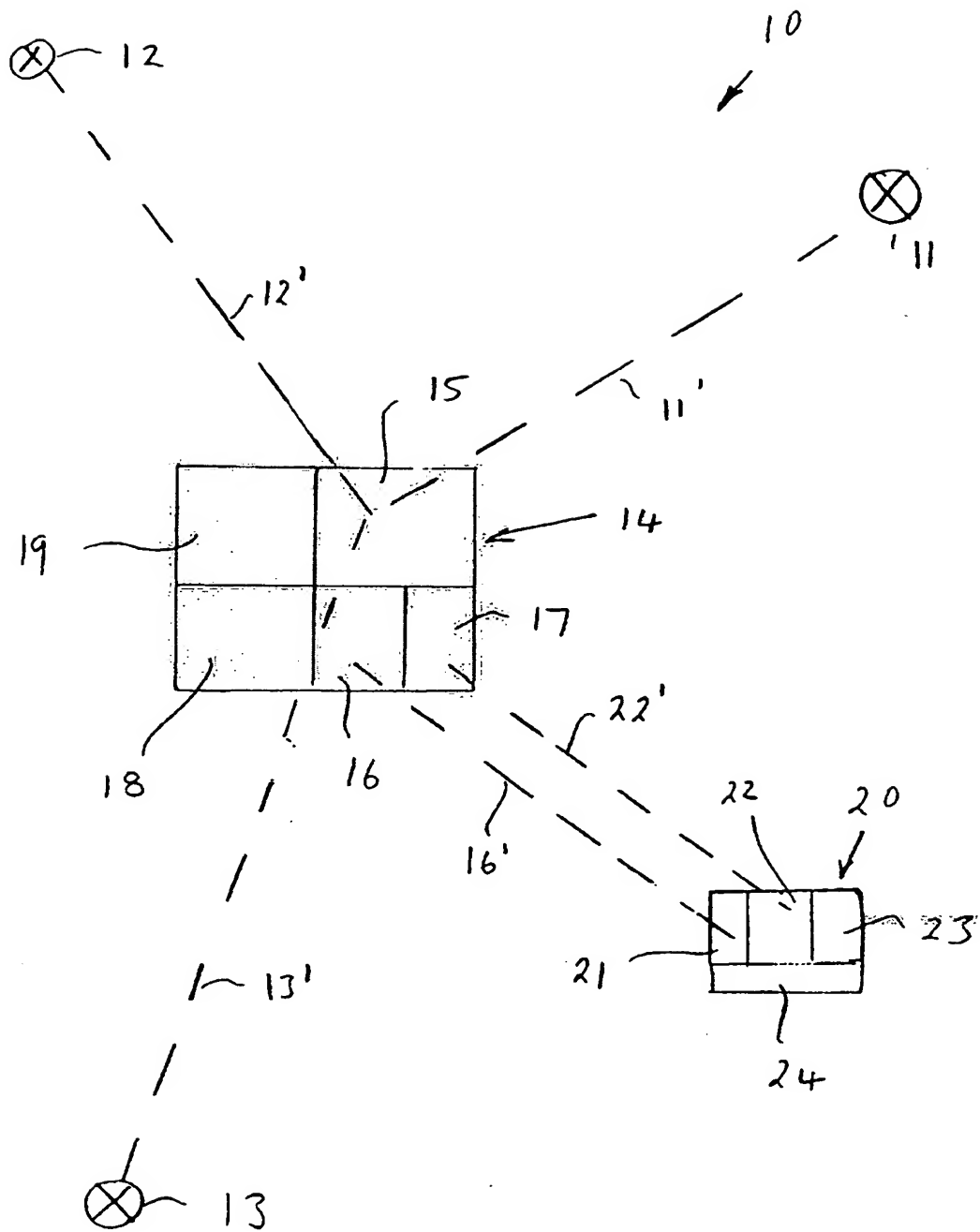
(54) Abstract Title  
**Location detector**

(57) A location detector system (10) for remotely establishing the position or any change of position of a movable object comprises at least two transmission devices (11, 12, 13) located spaced apart, each said device being operable to emit a signal indicative of a fixed location of that device; portable detection means (14) comprising (a) first receiver means (15) to receive signals transmitted by said transmission devices, and (b) second transmitter means (16) to emit a signal (16') which is a function of the position of the portable detection means in relation to said first transmitter means, second receiver means (21) to receive a signal emitted by said second transmitter means (16), and processor means (19) to process information represented by signals emitted by the transmission devices or the second transmitter means (11, 12, 13, 16). The second receiver may be a cellular telephone or incorporated into a wristwatch. Position may be transmitted intermittently at regular or random intervals; which may depend on speed or proximity to a boundary, or in response to detection of an alarm condition.



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## LOCATION DETECTOR

This invention relates to apparatus and a system comprising apparatus for detecting the location or change of location of an object and in particular, but not exclusively, the location or change of location of a movable object. The invention relates also to a method for detecting the location or change of location of an object.

The provision of means for establishing the location of a movable object (which term is used herein to include humans and other animate beings) in a cost effective, reliable and accurate manner is seen increasingly as of major importance in furthering attempts to improve security measures and procedures. Global positioning satellites (GPS's) often are employed for establishing the location of an object, but usually the degree of accuracy attainable is insufficient to be of practical value. Typically use of conventional GPS equipment will enable the position of an object to be established only to within the nearest 30 to 100 metres. Particularly for security monitoring purposes it is most desirable also to establish a position to within 5 to 10 meters or less.

The present invention seeks to provide an improved system, apparatus and means for use as a location detector. The invention seeks also to provide an improved method for detecting the location or change of location of an object. A further, ancillary, object is to provide a system and method which is capable of or comprises self-determination of operation.

In accordance with one aspect of the present invention a location detection system for use in detecting the location or change of location of a movable object comprises:-

first transmitter means comprising at least two transmission devices located spaced apart, each said device operable to emit a signal indicative of a fixed location of that device;

portable detection means comprising first receiver means to receive signals transmitted by said transmission devices, and second transmitter means to emit a signal which is a function of the position or change of position of the portable detection means in relation to said first transmitter means,

second receiver means to receive a signal emitted by said second transmitter means, and

processor means to process information represented by signals emitted by at least one of the first and the second transmitter means.

The first transmitter means may comprise at least three transmission devices spaced apart in a non-linear configuration, and the first receiver means may be adapted to receive signals transmitted by each of said three transmission devices.

The detection system may comprise also output means operable to provide an output related to the position of the location means and thus any object to which the location means is attached or with which it is movable.

The second receiver means may be integral with one of the at least two transmission devices of the first transmitter means or it may be independent therefrom so that the location of a movable object can be determined by means which is itself movable.

The second receiver means may, for example, be part of a device which performs other functions such as time-keeping, telephone communication, and/or the function of a system output means. The second receiver means may be an integral part of a telephone or of a wrist watch, and the (LCD) time display of the watch or telephone may serve also as the aforescribed output means.

Typically the transmitter and receiver devices will communicate by radio frequency waves but other forms of communication are within the scope of the invention including microwaves. It is envisaged that the system of the invention may utilise the transmitter devices provided in known manner for cellular telephone communications (e.g, Cellnet, Vodaphone or Orange), and which commonly use digital technology.

The processor means may be integral with the portable detection means and may be operable to process signals from the respective transmission devices of the first transmitter means and to emit to the second receiver means a signal representative of the calculated position or position change of the detection means either as an absolute position or as a position relative to a known datum position such as an at least temporarily fixed and known location of at least a part of the first transmission means.

Alternatively the detection means may be of a kind which operates to onward transmit to the second receiver means the signals received from transmission devices of the first transmitter means. The processor means may be integral with the second receiver means (which in turn may be integral with a

transmission device of the first transmission means) or it may be located separate therefrom. It may be in radio communication with the second receiver means or may communicate via a cable or other means such as an optical link. In the case of a movable second receiver means, such as one located within a device such as a wrist watch or telephone, the processor means may be located within that device.

The processor means may be of a kind which performs a calculation by a triangulation technique known per se in order to determine a position or change of position from the signals received from said at least two transmission devices of the first transmitter device. It or another part of the system may have a variable sensitivity or zoom facility.

The second transmitter device may be of a type which emits an identity signal which is unique to or characteristic of that transmitter device, i.e. the portable detection means. Thus if the system comprises a plurality of portable location detection means, the output means nevertheless may distinguish between the different detection means

The detection means may comprise an integral power source such as a battery, typically a long life or re-chargeable battery, to provide a source of electrical power to operate electronic or electrical components present in the location detection means. Additionally or alternatively the detection means may comprise a solar cell which may directly power components in the location means and or charge a battery.

The output means may be operable to provide for example a printed output or a visual display, for example on a monitor screen, an LCD device or an illuminated display. It may alternatively or additionally provide an audible output for example to provide a warning signal in the event of any movement or change of velocity of an object or movement outside a predetermined area. The aforementioned printed or visual display similarly may be accompanied by a warning type signal in the event of a pre-determined type of movement or change occurring.

Optionally the location detection means, or a device incorporating the second receiver means, may comprise at least a part of said output means. Thus the location means may comprise an LCD display or the like and operable to display position or movement information, which information also may be displayed on static output display means. An output means may have a visual display which displays information by the use of an arrow. The output means may automatically adjust resolution depending on the

distance between the furthest transmission device and the portable location detection means,

The portable location detection means may comprise a sensor device operable to generate or cause a warning signal to be transmitted to the second receiver means in the event of a pre-determined condition occurring, such as onset of movement or change of speed or direction of movement of the location means. That sensor means may be of a kind which determines movement, or occurrence of any pre-determined condition, independently of any signals from the first transmission means or it may be responsive to change in signals from the first transmission means.

The portable detector means or other part of the location detection system may incorporate timer means whereby power consumption of at least the portable location means is moderated by operating at least the second transmitter means only on an intermittent basis.

The portable location means may be operated at regular intervals of time, and those intervals may be fixed at a constant period, or they may be selectively adjustable. Alternatively the time intervals may be randomly or otherwise variable.

The time interval may be a function of the position or velocity of the object, i.e. the faster the motion of the object or the closer it comes to an established boundary, the shorter the time interval. The time interval may be arranged to be less than the time required by the object, when moving at it's last known speed, to reach an established boundary, for example a boundary at which position an alarm signal is required to be generated.

The system may incorporate actuation means, which may comprise a third transmitter means associated (and for example movable) with the second receiver means, for operation to initiate the timer means and or directly activate the portable location detection means.

The portable location detection means optionally may be a device which performs other functions, such as time-keeping. The portable location detection means may be an integral part of a wrist watch, irrespective of whether or not the second receiver means is integral with another multi-function device such as a wrist watch or telephone.

In accordance with another aspect of the present invention a portable detection means for association with an object to facilitate detecting the location of an object or any change of location comprises;

first receiver means to receive signals transmitted by each of at least two non-rectilinearly positioned transmission devices of a first transmitter means;

second transmitter means to emit a signal which is a function of the position or change of position of the portable detection means in relation to said first transmitter means;

second receiver means to receive a signal emitted by said second transmitter means, and

an electrical power source.

Said detection means may comprise a processor means and or a sensor device as aforescribed in respect of a detection means in accordance with a location detection system of the present invention.

The present invention provides also a method for establishing the position or any change of position of a movable object, said method comprising:-

providing first transmitter means comprising at least two transmission devices located spaced apart, each said device being operable to emit a signal indicative of a fixed location of that device;

providing portable detection means comprising first receiver means to receive signals transmitted by said transmission devices, and second transmitter means to emit a signal which is a function of the position of the portable detection means in relation to said first transmitter means,

providing second receiver means to receive a signal emitted by said second transmitter means, and

arranging processor means to process information represented by signals emitted by at least one of the first and the second transmitter means.

The method may comprise use of a transmitter means comprising at least three transmission devices spaced apart in a non-linear configuration, and the first receiver means may be adapted to receive signals transmitted by each of said three transmission devices.

The invention further teaches the provision of a security facility whereby only an authorised user can access information concerning the location or change of location of a person or a valuable object which carries a portable detection means. For that purpose means such as a key pad or voice recognition device may be interconnected with the aforescribed output means.

One or more parts of a system, e.g. a portable location detector and or a second receiver means, may have associated therewith a panic alarm device.

Uses for the system include acting as a car alarm, property alarm, pet locator, home security, orienteering and mountain rescue, and as a blind persons homing device that employs tone sounds to facilitate direction finding. There may be an audible warning system to assist movement of visually impaired users.

In the system, portable detection means, or method of the invention it may be provided that the second transmitter means operates at a frequency different from a first transmitter means

One embodiment of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawing of a system in accordance with the present invention.

A location detection system 10 comprise a first transmitter means comprising an array of ground based first transmission devices 11,12,13 three of which are shown in the drawing and are disposed non-rectilinearly. The transmission means 11,12,13 are part of a large array of digital technology radio frequency transmitters of a cellular telephone system.

A portable detection means 14 of the present invention comprises a first receiver means 15 to receive signals from the three transmission devices 11,12,13 and a second transmission device 16 which emits a signal 16' related to the signals received from the three transmission devices 11,12,13. The signal 16' is received by a second receiver device 21 which is part of a wrist watch 20 (but could for example alternatively be a telephone) that operates as a multi-function device to provide also a time display.

The detection means 14 comprises also a timer 17, described in more detail below, a long life battery 18 and a processor device 19. The processor 19 processes the signals 11',12',13' from the three transmission devices 11,12,13 to generate a signal which is related to the position of the detection means relative to the devices, e.g. as a distance and bearing relative to one



of the devices 11,12,13 or as the distances from two of those devices. The output of the processor provides the information carried by the signal 16'.

The watch 20 includes a solar cell 24 which maintains charge in a battery (not shown,) and an LCD display 23.

The watch also comprises a timer actuation means 22 which incorporates a third transmission means to emit a signal 22' for control of the timer 17. The actuation means emits a trigger signal at prescribed intervals, adjustable by a control on the watch, to trigger the device 14 to perform a location ( or movement ) calculation at corresponding time intervals.

The actuation means is operable also to vary the frequency of the signals 22' in accordance with information received from the signal 16'. Thus if the device is moving to a potential danger zone or into forbidden territory, a more frequent monitoring of position is automatically effected.

The display 23 is selectively operable to display location or movement information related to the signal 16'. In addition to providing a visual output on the LCD display 23, the system incorporates in the watch 20 an audible alarm which emits a warning sound in the event of an undesired condition arising or becoming imminent. The warning signal is actuated in response to operation of the processor to identify the occurrence or imminence of the undesired condition.

It is to be understood that the system described above with reference to the drawing may be adapted to incorporate one or more of the other features disclosed herein in the preceding part of this description.

## Claims:

1. A location detection system for use in detecting the location or change of location of a movable object, said system comprising:-

first transmitter means comprising at least two transmission devices located spaced apart, each said device being operable to emit a signal indicative of a fixed location of that device;

portable detection means comprising first receiver means to receive signals transmitted by said transmission devices, and second transmitter means to emit a signal which is a function of the position or change of position of the portable detection means in relation to said first transmitter means,

second receiver means to receive a signal emitted by said second transmitter means, and

processor means to process information represented by signals emitted by at least one of the first and the second transmitter means.

2. A location detection system according to Claim 1, wherein the first transmitter means comprises at least three transmission devices spaced apart in a non-linear configuration.

3. A location detection system according to Claim 2, wherein said first receiver means is adapted to receive signals transmitted by each of said three transmission devices.

4. A location detection system according to any one of the preceding claims, wherein the system comprises also output means operable to provide an output related to the position of the portable location detection means.

5. A location detection system according to any one of the preceding claims, wherein the second receiver means is integral with one of the at least two transmission devices of the first transmitter means.

6. A location detection system according to any one of the preceding claims, wherein the second receiver means is part of a device which performs one or more of the functions of time-keeping, telephone communication, and/or the function of a system output means.
7. A location detection system according to the preceding claims, wherein the second receiver means is an integral part of a telephone or of a wrist watch.
8. A location detection system according to any one of the preceding claims, wherein the transmitter and receiver devices communicate by radio frequency waves.
9. A location detection system according to any one of the preceding claims, wherein the portable detection means is operable to onward transmit to the second receiver means a signal received from transmission devices of the first transmitter means.
10. A location detection system according to any one of Claims 1 to 8, wherein the processor means is integral with the second receiver means.
11. A location detection system according to any one of Claims 1 to 8, wherein the processor means is integral with the portable detection means and is operable to process signals from the respective transmission devices of the first transmitter means and to emit to the second receiver means a signal representative of the calculated position or position change of the detection means.
12. A location detection system according to any one of the preceding claims, wherein the second transmitter device is operable to emit an identity signal which is unique to or characteristic of that transmitter device.

13. A location detection system according to any one of the preceding claims, wherein the output means is operable to provide an audible output in the event of a pre-determined type of movement or change of velocity or movement.

14. A location detection system according to any one of the preceding claims, wherein the location detection means, or a device incorporating the second receiver means, comprises at least a part of said output means.

15. A location detection system according to any one of the preceding claims, wherein the output means is operable automatically to adjust resolution depending on the distance between the furthest transmission device and the portable location detection means.

16. A location detection system according to any one of the preceding claims, wherein the portable location detection means comprises a sensor device operable to generate or cause a warning signal to be transmitted to the second receiver means in the event of a pre-determined condition occurring.

17. A location detection system according to Claim 16, wherein said sensor means is of a kind which determines movement, or occurrence of any pre-determined condition, independently of any signals from the first transmission means.

18. A location detection system according to Claim 16, wherein said sensor means is of a kind which determines movement, or occurrence of any pre-determined condition, in response to change in signals from the first transmission means.

19. A location detection system according to any one of the preceding claims, wherein the portable location detection means or other part of the location detection system incorporates timer means whereby power consumption of at least the portable location means is moderated by operating at least the second transmitter means only on an intermittent basis.

20. A location detection system according to any one of the preceding claims, wherein the portable location means operates at regular intervals of time.

21. A location detection system according to any one of Claim 1 to 19, wherein the portable location means operates at regular intervals of time which are randomly or otherwise variable.

22. A location detection system according to Claim 20 or Claim 21, wherein the time interval is a function of the position or velocity of an object.

23. A location detection system according to any one of claims 20 to 22, wherein the time interval is arranged to be less than the time required by an object, when moving at it's last known speed, to reach an established boundary .

24. A location detection system according to Claim 1 and substantially as hereinbefore described

25. A portable detection means for association with an object to facilitate remotely detecting the location of the object or any change of location, said detection means comprising:-

first receiver means to receive signals transmitted by each of at least two non-rectilinearly positioned transmission devices of a first transmitter means;

second transmitter means to emit a signal which is a function of the position or change of position of the portable detection means in relation to said first transmitter means;

second receiver means to receive a signal emitted by said second transmitter means, and

an electrical power source.

26. A portable detection means according to Claim 25, wherein said detection means comprises one of a processor means and a sensor device as recited in any one of claims 1 to 24.

27. A portable detection means according to claim 25 and substantially as herein before described.

28. Method for establishing the position or any change of position of a movable object comprising:-

providing first transmitter means comprising at least two transmission devices located spaced apart, each said device being operable to emit a signal indicative of a fixed location of that device;

providing portable detection means comprising (a) first receiver means to receive signals transmitted by said transmission devices, and (b) second transmitter means to emit a signal which is a function of the position of the portable detection means in relation to said first transmitter means,

providing second receiver means to receive a signal emitted by said second transmitter means, and

arranging processor means to process information represented by signals emitted by at least one of the first and the second transmitter means.

29. Method according to Claim 28, wherein use is made of a transmitter means comprising at least three transmission devices spaced apart in a non-linear configuration, and the first receiver means receives signals transmitted by each of said three transmission devices.

30. Method according to Claim 28 or Claim 29, wherein the portable location detection means is attached to a person or object and only an authorised user can access information concerning the location or change of location of said person or object.

31. Method according to any one of Claims 28 to 30, wherein the second transmitter means is operated at a frequency different from the frequency at which the first transmitter means is operated.

32. Method according to Claim 28 and substantially as hereinbefore described.



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Claims searched: all

Examiner: Dr E P Plummer  
Date of search: 25 November 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.P):

Int CI (Ed.6): G01S

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage		Relevant to claims
X	EP0767594A2	NOKIA MOBILE PHONES whole document	1-6,8,10, 11,12,14, 25,26-31
X	WO97/13160A1	HMW CONSULTING whole document; nb figure 3	1-8,10,11, 12,14,19, 20,21,25, 26,28-31
X	WO97/04332A1	KURTH whole document, eg pages 4 to 9	25
X	WO96/30884A1	PEDERSEN whole document	1-4,6,8, 10,11,12, 14,25,26, 28-31
X	WO96/27972A1	XYPOINT CORP whole document, eg page 2 first paragraph	25
X	WO96/05659A1	STANFORD TELECOMMUNICATION whole document	1-8,10-14, 16,17,18, 25,26, 28-31

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